IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: David M. Mills et al.	§	Group Art Unit:	3768
Serial No.: 10/676,202	§	Examiner:	Jaworski, Francis J.
Filed: October 1, 2003	§		
For: Focusing Micromachined Ultrasonic Transducer Arrays and Related Methods of Manufacture	§	Atty. Docket:	132147-2 GERD:0566/SWA

Mail Stop Amendment
Commissioner for Patents
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37 C.F.R. 1.8

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5 25 07
Date

Sennelle Dice

Sir:

DECLARATION OF DAVID M. MILLS UNDER 37 C.F.R. § 1.131

I, David M. Mills, hereby declare as follows:

1. I am a co-inventor of record of the invention disclosed and claimed in the above-referenced application.

2. My residence and business addresses are set forth below, along with my signature.

3. We conceived the subject matter disclosed and claimed in the above-referenced application at least prior to August 31, 2001. This conception is evidenced by a printout of a draft disclosure letter prepared prior to August 31, 2001, having a description and computer-generated diagrams of embodiments of the invention. A redacted printout of this draft disclosure letter is attached hereto as Exhibit A. This draft disclosure letter describes an ultrasonic probe having a curved lens attached to an array of micromachined ultrasonic transducers. *See* Exhibit A.

Furthermore, the diagrams included in the draft disclosure letter show a MUT cell with multiple regions. *See id.* The diagrams also show several types of curved lenses. *See id.*

4. We actually reduced to practice the subject matter disclosed and claimed in the above-referenced application at least prior to August 31, 2001. This actual reduction to practice is evidenced by a study including a photograph, taken prior to August 31, 2001, which shows the claimed subject matter. Specifically, the photograph shows a curved lens attached to an array of micromachined ultrasonic transducers. A redacted printout of this study is attached hereto as Exhibit B. For purposes of clarity, numerical labels have been added to this photograph as discussed below. *See* Exhibit B. This photograph illustrates an embodiment of the claimed subject matter, including a curved lens 10 successfully attached to an array of MUT cells 12. *See id.*

I declare further that all statements made herein are of my own knowledge, are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Dated: May 24, 2007 By: David M. Mills

David M. Mills

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EXHIBIT A

DISCLOSURE LETTER OUTLINE

Building [redacted] Room: [redacted]

Date: [redacted]

[redacted]

Inventors: Douglas G. Wildes
Robert S. Lewandowski
L. Scott Smith
David M Mills

Laboratory Manager of each inventor:* [redacted]

Building [redacted] Room: [redacted]

SCHENECTADY, NEW YORK

SUBJECT: PATENT DISCLOSURE LETTER

on: Focusing micromachined ultrasounic transducers

1. OBJECT OF INVENTION [redacted]

[redacted]

2. DESCRIPTION OF INVENTION

In the simplest form, a polymeric lens (having a different velocity of sound than water) with a curved profile in elevation (i.e. cylindrical as in Fig. 1b) can be attached to the face of the cMUT array (Fig. 1a). Other lens ideas include a multifocal lens, Fig. 1c, to allow for multiple focal regions and acylindrical lenses, Fig. 1c-d, to eliminate cylindrical lens aberrations. Any lens applied to the face of the cMUT can also act as a protective layer both for the cMUT and also to prevent exposure of high voltage to the outside (i.e. a patient in medical ultrasound applications). A protective layer without focusing characteristics (i.e. a flat layer) may also be applied to the face of the cMUT. The cMUT needs to be protected from external shock from dropping, sharp instruments, or any other mechanical stress that may puncture membranes or in some other way damage the device. External environmental conditions, such as water, sterilizing liquids, or other fluids that may be applied to the surface, could damage the device and thus the cMUT needs to be protected against them.

Attachment of the lens or protective layer can be by casting it directly on to the cMUT array or by bonding a preformed or precast lens to the face of the cMUT. In this case, an additional protective lining may be applied to the inside of the lens to provide additional insulation. Casting the lens in place may be the preferred method due to the possibility of breaking the cMUT membranes while applying pressure to bond a preformed lens in place.

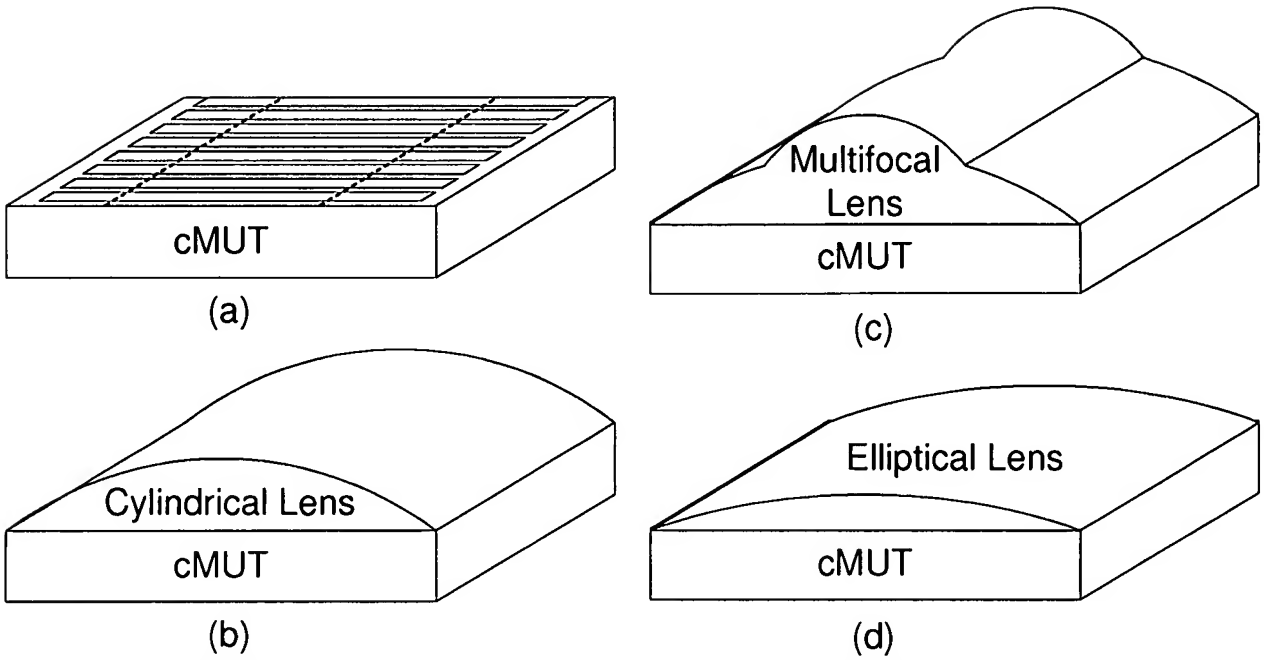
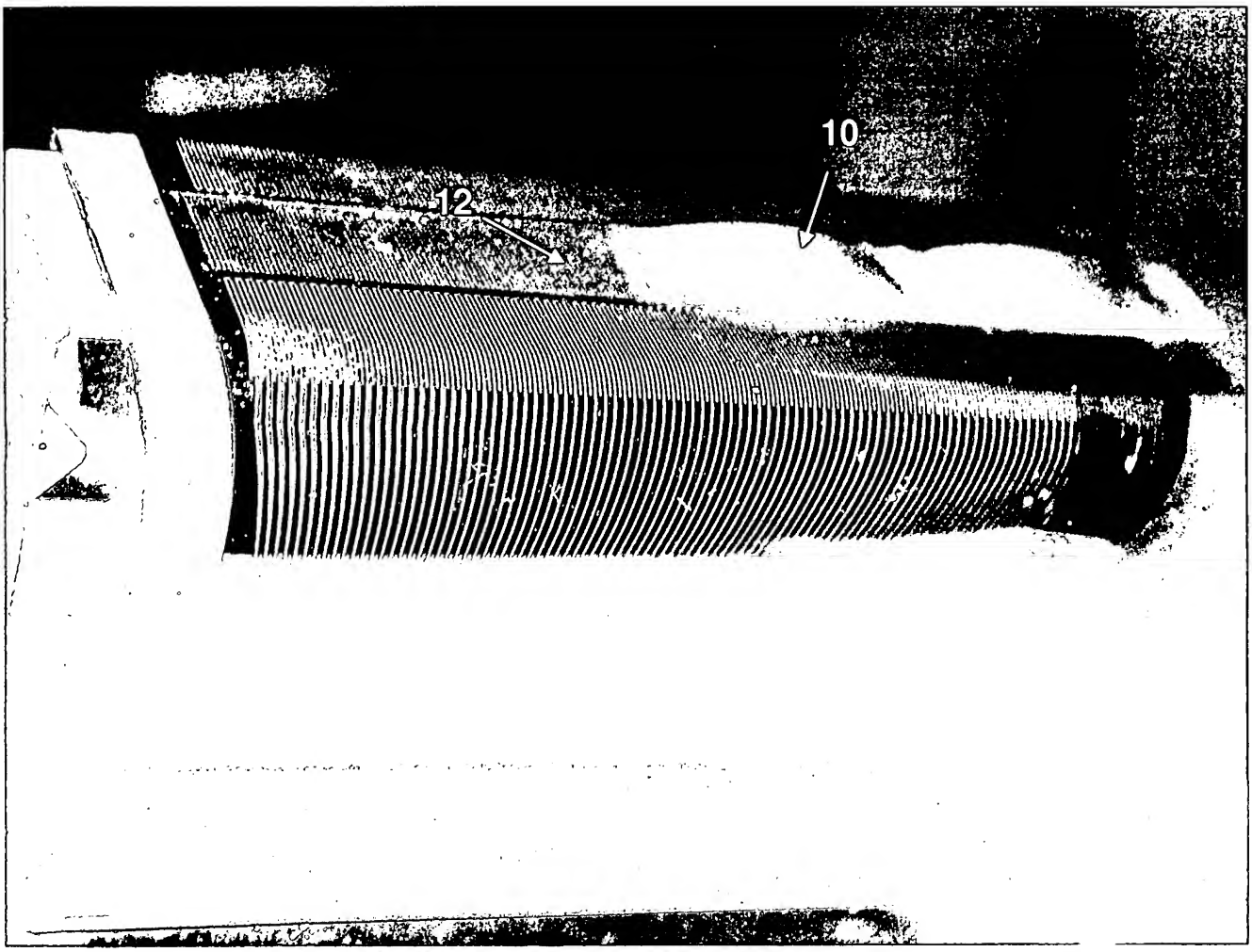


Figure 1. A cMUT device (a) showing individual elements of a linear array in the azimuthal dimension and an optional 1.5-D array configuration for a multifocal lens (dotted line shows separation of the individual elements in to three elements in elevation), and three different types of lenses for this cMUT: (b) cylindrical, (c) multifocal, and (d) elliptical (both b and c are examples of acylindrical lenses).

Care must be taken when selecting the material to use for the lens as the characteristics of the lens are important to obtaining a robust ultrasound probe. Acoustically, it must have a similar impedance, the product of density and speed of sound in the material, to that of water so as to avoid sound reflections at the lens/water interface. As stated above, it must also have a different speed of sound than water, preferably lower than water for the case in Fig. 1, so as to focus the acoustic wavefront in the elevation plane. The acoustic attenuation of the lens must also be low to maximize the transmission of sound through the lens and minimize heating. Chemical properties, such as water permeability, must also be carefully selected to keep chemicals away from the cMUT. The lens must also be durable so that it can be used many times without tearing or cracking due to material fatigue.

EXHIBIT B

cMUT Lensing Study [redacted]



The photograph above shows a partially lensed cMUT with two lens strips over one end of the array.

[redacted]